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Precautionary Saving from Different Sources of Income

Evidence from Rural Pakistan

Richard H. Adams Jr.

Much of past literature has assumed that households in developing countries save at the same marginal rate from all sources of income. But in rural Pakistan households save at very different marginal rates from different souces of income. The marginal propensity to save from those sources of income that are more variable and uncertain—like external remittances—is much higher than from those sources of income that are more predictable—like rental income.

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Summary findings

Few studies have tried to measure how households in a developing country save from each of the different income sources at their disposal. To help fill that gap, Adams uses five-year panel data to examine how households in rural Pakistan save from each of seven separate sources of income.

Adams finds that households save from different sources of income at significantly different marginal rates. For example, the marginal propensity to save from external remittances (0.711) is much higher than that for rental income (0.085). As the precautionary model of saving suggests, the reasons for this relate to uncertainty: income that is more variable tends to be saved at a higher marginal rate. Faced with incomplete capital and credit markets, households in rural Pakistan save "for a rainy day" by putting away mainly those sources of income that are more variable and uncertain.

This paper—a product of the Poverty Reduction Group, Poverty Reduction and Economic Management Network—is part of a larger effort in the network to understand how households use savings for investment and development in developing countries. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Nelly Obias, room MC4-834, telephone 202-473-1986, fax 202-522-3283, email address nobias@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at radams@worldbank.org. January 2002. (31 pages)

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The propensity to save from different sources of income has received considerable attention in the literature on economic development [Bhalla, 1978, 1979, 1980; Musgrove, 1979; Wolpin, 1982; Gersovitz, 1988; Deaton, 1990, 1992; Morduch, 1990; Paxson, 1992; Alderman, 1996]. However, none of these studies attempt to measure how rural households in a developing country save from each of the full complement of income sources at their disposal.[1] At least four reasons exist for this neglect. First, from a theoretical standpoint, many analysts simply assume that the marginal propensity to save (MPS) from one source of income is the same as that for income from any other source. In other words, a dollar is a dollar and households do not base their saving behavior on the particular source of income. Second, some analysts argue that while the MPS may differ between sources of income, the reasons for this relate more to the variability of income rather than to the special characteristics of any particular income source. For example, the precautionary saving model suggests that marginal rates of saving are positively correlated with the variability or uncertainty of income. That is, at the household level sources of income which are more variable and less certain will be saved at a higher marginal rate, all other things being equal. Third, from a more practical standpoint, the whole topic of how households save from different sources of income is not easy to analyze. The intertemporal nature of saving means that panel data on the

behavior of households over time is needed, if the lifetime behavior of households is not to be inferred from the behavior of contemporaneous cohorts of different ages. And, unfortunately, there is a dearth of panel data sets -- in both developed and developing counties -- which provide good information either on saving or on saving by type of income. Fourth, even when panel data on savings exist, saving itself has proved to be a notoriously difficult variable to measure [Deaton, 1990]. For example, at the household level saving is often measured as the residual between observed income and observed expenditures. If it is true that household surveys tend to under report income, then saving would be underestimated. Also, measuring saving as the difference between observed income and observed expenditures has the potential of introducing a correlation between the dependent and independent variables when saving is studied with regression analysis. The resulting marginal propensities to save may thus be biased.

The purpose of this article is to analyze how households save from each of the full complement of income sources at their disposal by making use of a unique, 5-year panel data set from rural Pakistan. The article seeks to make three contributions. First, the panel data from Pakistan are used to estimate saving functions in which the marginal propensities to save from seven different sources of income – non-farm, agricultural, livestock, rental, external remittances, internal remittances and other – are allowed to differ. This exercise shows that incomes from different sources of income are, in fact, saved at different marginal rates. Second, the paper shows that the reasons for this saving behavior are related to uncertainty. As suggested by the precautionary saving model, sources of income which are more variable and less certain tend to be saved at higher marginal rates. Third, in this study the availability of observed estimates of saving makes

it possible to overcome the correlation of errors problem in estimating income and saving which bedevils other empirical studies. This allows a more precise means of analyzing saving behavior from different sources of income.

The balance of this study is organized as follows. Section 1 presents a model of household saving. Section 2 presents the data set and discusses the construction of different measures of saving. Section 3 operationalizes the saving model and Section 4 presents empirical results which show that incomes from separate sources are, in fact, saved at different marginal rates. These findings lead in Section 5 to a discussion of how these results conform to a precautionary model of saving and how income variability and uncertainty affect savings. Section 6 concludes.

1. A Model of Household Saving

A simple, two-period consumption-saving model can be written as:

$$\max U(c_1) + \delta EU(c_2) \qquad (1)$$

where the household maximizes utility (U) based upon its consumption (c) in time period 1, and its expected utility (EU) based upon its consumption in time period 2.

With multiple sources of income (y_n; n = 1, . . .N), if incomes are certain in both periods, the budget constraint in the second period becomes:

$$c_2 = (1 + r)\,(\sum_n y_{n1} - c_1) + \sum_n y_{n2} = (1 + r)(Y_1 - c_1) + Y_2 \qquad (2)$$

where r equals the real rate of interest, and Y is total income.

From equation (2) it follows that consumption, or saving, should depend on total income irrespective of source. This implication would hold regardless of how many time periods are under consideration, whether or not individuals can borrow, and whether or

not the real rate of interest is known.

However, equation (2) is not very realistic because in most situations, incomes are uncertain in the second period, and different sources of income may be more or less predictable. This uncertainty about incomes can be modeled in several ways, one possibility being (vector) auto-regressive:

$$y_{n,\,t+1} = \alpha_n + \sum_j \alpha_{nj}\, y_{j,t} + u_{nt} \qquad (3)$$

where u_{nt} is the variance of income source n in time t.

From equation (3) the consumer-saver's problem now becomes:

$$\max U(Y_1 - s) + \delta EU(s(1 + r) + Y_2) \,|_{yn1;n=1,..N} \qquad (4)$$

The expression $E\,|_{yn}$ refers to the conditional expectation of future income given current income. In equation (4) y_{nt} affects s_t in two ways: first, it affects current income in a symmetrical manner across income sources; and second, it influences the expectation of future income in a manner that is asymmetric as long as a_{nn} differs across n.

Equation (4) isolates several points that will be pursued in this paper. If, for example, "risk" is measured not by income variance, but rather by income predictability, then the variance of u_{nt} becomes crucial. In other words, some sources of income may be more predictable than others (e.g., α_{nn} close to 1), and thus one might expect a lower marginal propensity to save from these more predictable income sources. In more concrete terms, the variance of rental income may be high in the cross-section of households, but relatively stable and predictable over time for the household. If rental income is high in the first period, then the household will predict that it will also be high in the second period, and this means that it has to save less out of rental income in the

present to finance consumption in the future.

Equations (3) and (4) thus set out the bare bones of a model with parameters -- α_{nj}, b, δ and c^* -- which can be estimated and tested as a joint null hypothesis. This model will be operationalized and estimated in Sections 3 and 4.

2. Data

a. The Data Set

Data were collected in a series of 14 interviews with 469 households over a five-year time period (1986-87 to 1990-91) in rural Pakistan. In these interviews data were collected on a wide range of topics, including income, expenditures, saving, education and household assets.[2]

While intensive in nature, this survey was not designed to be a representative study of saving in rural Pakistan as a whole. Rather the survey was quite focused, that is, it was designed to analyze the determinants of poverty in rural Pakistan. To these ends, the "poorest" district in each of three Pakistan provinces was selected for surveying, with poverty being defined on the basis of a production and infrastructure index elaborated by Pasha and Hasan [1982]. The selected districts included Attock (Punjab province), Badin (Sind province) and Dir (Northwest Frontier province). Since rural poverty also exists in more prosperous areas, a fourth district Faisalabad (Punjab province) was also added to the sample.[3]

Table 1 presents summary data for consumption expenditure and income in the survey. All figures in the table are expressed in real per capita terms by deflating to a base year (1986-87) using district-specific consumer price indices, consisting of food and

nonfood price indices weighted by their respective average budget shares. These price indices were constructed from survey data; they suggest that inflation during the study period averaged 21.7 percent per year.[4]

As shown in Table 1, the seven sources of income in the survey include:

(1) Non-farm - Includes wage earnings from non-farm labor, government and private sector employment plus profits from non-farm enterprises;

(2) Agricultural - Includes net income from all crop production including imputed values from home production and crop by-products plus wage earnings from agricultural labor;

(3) Livestock - Includes net returns from traded livestock (cattle, poultry) plus imputed values of home-consumed livestock plus bullock traction power;

(4) Rental - Includes rents received from ownership of assets such as land, machinery and water;

(5) External remittances - Includes income (money and goods) received from an international migrant;

(6) Internal remittances - Includes income (money and goods) received from an internal migrant in Pakistan;

(7) Other - Includes pensions (government), cash and zakat (alms payments to the poor).

All income figures in Table 1 are in net terms. This means that the remittance figures are calculated net of any household-to-migrant flows and direct migration costs.

b. Alternative Saving Measures

Using these data, there are at least two ways to measure saving. Each of these saving measures has its own type of measurement problems.

The first measure, SAVE1, is defined as the difference between observed income and observed consumption expenditure. SAVE1 is a traditional measure of saving and roughly corresponds to the concept of saving used in the national accounts. However, SAVE1 is subject to at least two kinds of measurement error. First, SAVE1 may overestimate saving because it includes all expenditures on durable goods. While some durable goods (like vehicles) may be considered a type of investment since they yield a flow of services over a number of years, other durable goods (such as household goods) represent a more problematic type of investment. Second, SAVE1 is not measured directly but is rather measured as the residual between two variables (income and expenditures), each of which is likely to be measured with error. As discussed above, such measurement error may have the effect of biasing estimates of the marginal propensities to save for the various sources of income upward toward 1.

The second saving measure, SAVE2, is defined as net real and financial saving, that is, (expenditures on land purchase, land improvement, animal purchase, education, building and financial savings) minus (income from land sales, animal sales and other sales). SAVE2 has the distinct advantage of being an observed variable, and thus it is uncorrelated with errors in estimating income. Moreover, SAVE2 also explicitly includes education expenses, which is an important, but often-neglected, type of human capital investment. However, SAVE2 may suffer from its own type of measurement problems, since net loans are not included. In all likelihood, SAVE2 also underestimates gold and jewelry holdings, but these forms of saving are seldom accurately captured in any

household survey.

Finally, it should be noted that both SAVE1 and SAVE2 variables are measured on the basis of flows, and thus, do not take into account depreciation of real assets. This decision can be justified on the grounds that many rural assets (like housing) are very difficult to price, and thus any depreciation rate is essentially arbitrary.

Table 2 presents summary data for SAVE1 and SAVE2 ranked by income quintile group. Unlike other household surveys in developing countries, which often (and somewhat implausibly) find that the bottom 50 to 80 percent of the income distribution is dissaving [Deaton, 1992: 139], average saving rates are relatively high. In Table 2 SAVE1 (income minus consumption expenditure) is negative only for the two lowest income groups; for the top quintile, the average rate of saving is a very high 47.0 percent. The reason for this high figure is probably measurement error: since SAVE1 includes all expenditures on durables, it tends to overestimate the rate of saving for all groups, and especially for the rich. By comparison, SAVE2 (net real and financial savings) does not show negative saving for any group and generally records less variation in saving rates across income quintiles. For the top quintile group, SAVE2 suggests a more reasonable average rate of saving of 21.3 percent.

3. Operationalizing the Saving Model

Following the notation of section (1), a standard saving model can be written as:

$$S = a_n + b_1(y_{in1} + y_{in2} + \ldots + y_{int}) + error_{int} \qquad (5)$$

where S is saving and y_{int} represents the income of household i from any of n sources in year t.

Equation (5) is rather sparse. Work by other analysts, such as Deaton [1990, 1992] and Paxson [1992], has suggested that saving may be affected by other factors, such as life-cycle variables and education. On this basis, equation (5) can be rewritten as:

$$S = a_n + b_1(y_{in1} + y_{in2} + \ldots + y_{int}) + b_2\Delta HAGE + b_3\Delta MEDUC + error_{int} \quad (6)$$

where ΔHAGE is a vector of household age variables and ΔMEDUC is a vector of education variables for household males.

In equation (6) parameter b_1 is the short-run marginal propensity to save (MPS). Parameter b_2 measures a vector of household-age variables that capture the number of household members in different age categories. In general, life-cycle models suggest that households with greater numbers of young children and older people can be expected to save less, since the current labor income of these household members is less than the annuity value of their lifetime wealth. Finally, parameter b_3 measures a vector of male education variables.[5] Although theoretically ambiguous, it is of empirical interest to find out whether more educated households -- that is, those with more educated males -- save more.

Equation (6) assumes that the MPS does not differ by source of income. However, if incomes from more variable sources are saved at higher marginal rates, then equation (6) is inappropriate. In such a case:

$$b_1 = f(VAR_{in1} + VAR_{in2} + \ldots + VAR_{int}) \quad (7)$$

where VAR represents the variability of the income of household i from any of n sources in time t.

If equation (7) is true, then a system of saving functions is needed which allows for

different rates of marginal saving for the various sources of income. A saving system meeting such a requirement can be written as:

$$\lambda_1 S_{it} = a_n + b_{01} + b_{11} y_{i1t} + b_{21}\lambda_1 \Delta HAGE_{it} + b_{31}\lambda_2 \Delta MEDUC_{it} + error_{int} \quad (8a)$$

$$\lambda_2 S_{it} = a_n + b_{02} + b_{12} y_{i2t} + b_{22}\lambda_2 \Delta HAGE_{it} + b_{32}\lambda_3 \Delta MEDUC_{it} + error_{int} \quad (8b)$$

$$\lambda_n S_{it} = a_n + b_{0n} + b_{1n} y_{int} + b_{2n}\lambda_n \Delta HAGE_{it} + b_{3n}\lambda_n \Delta MEDUC_{it} + error_{int} \quad (8c)$$

where the variability of each n source of income is captured by the various b's, and the λ's (which sum to 1) represent the unknown proportions of saving from the different income sources. Since the λ's are not known, equations (8a) through (8c) cannot be estimated directly. However, summing (8a) through (8c) over the n income sources yields the estimable function:

$$S_{it} = \sum_{s=1}^{n} \lambda_s S_{it}$$

$$= \sum_{s=1}^{n} (b_{0s} + b_{1s} y_{ist} + b_{2s}\lambda_s \Delta HAGE_{it} + b_{3s} \Delta MEDUC_{it}) + error_{int} \quad (9)$$

$$= b_0^* + \sum_{s=1}^{n} b_{1s} y_{ist} + b_2^* \Delta HAGE_{it} + b_3^* \Delta MEDUC_{it} + error_{int}$$

in which

$$b_0^* = \sum_{s=1}^{n} b_{0s}, \; b_2^* = \sum_{s=1}^{n} b_{2s}\lambda_s, \text{ and } b_3^* = \sum_{s=1}^{n} b_{3s} + error_{int}. \quad (10)$$

The saving function in equation (10) is especially useful because a priori assumptions about the propensity to save may be incorporated or tested directly. For example, if equal MPSs are assumed, then n = 1. Equal propensities to save incomes from different sources can also be tested by setting n > 1.

4. Estimation Results

The saving functions in equations (6) and (9) were estimated using the data described above. Dependent and independent variables were measured in real per capita household terms.

Initially, equation (6) was estimated under the assumption that incomes from different sources have a common MPS:

$$\text{SAVE1, SAVE2} = b_0 + b_1 Y_{TOT,it} + b_2 \Delta HAGE_{it} + b_3 \Delta MEDUC_{it} + error_{int} \quad (11)$$

The variables are defined in Table 3. The model was then estimated following equation (9) which allows the MPSs to differ by income source:

$$\begin{aligned} \text{SAVE1, SAVE2} = {} & b_0^* + b_{11} Y_{NF,it} + b_{12} Y_{AG,it} + b_{13} Y_{LV,it} \\ & + b_{14} Y_{RN,it} + b_{15} Y_{EXT,it} + b_{16} Y_{INT,it} \\ & + b_{17} Y_{OTH,it} + b_2^* \Delta HAGE_{it} + b_3^* \Delta MEDUC_{it} \\ & + error_{int} \end{aligned} \quad (12)$$

Equations (11) and (12) were estimated using ordinary least squares (OLS) on pooled, 5-year data. Estimates for the two different definitions of savings (SAVE1 and SAVE2) are presented in Tables 4 and 5. In both tables all of the income coefficients (except those for livestock and internal remittances) are statistically significant at the 5 percent level. In the tables some of the household age variables (HAGE) are statistically significant, but in only one case is the male education variable (MEDUC) significant.

Since it is likely that each household will have a different dispersion of saving,

White's general test for heteroskedasticity was performed. Results suggested that heteroskedasticity is present at the 5 percent level of significance in the "combined income" equations in both tables. Re-estimating these equations using weighted least squares failed to remove this heteroskedastictity; moreover, using weighted least squares produced regressions with insignificant F-statistics. The decision was thus made to use the OLS results. Fortunately, heteroskedasticity was not present in the OLS results for the "7 income components" equations in either table.

In Table 4 the F-statistic for the "7 income components" model suggests that the coefficients for the various sources of income are not statistically equal to one another. Further tests also reject the null hypothesis of equal coefficients for the income components in this equation at the 1 percent level of significance.

In Table 5 both the F-statistic for the "seven income components" model and further diagnostics produce identical results. In this table the coefficients for the various income components are also statistically different from one another at the 1 percent level.

To summarize, results for both the SAVE1 and SAVE2 models suggest that separate sources of income are saved at significantly different marginal rates. For example, in the SAVE1 model the MPS out of external remittances (0.907) is much higher than that (0.589) out of internal remittances. Likewise, in the SAVE2 model the MPS out of other income (1.025) is twelve times higher than the MPS for rental income (0.085).

In general, the MPSs for the separate sources of income are much higher for SAVE1 than SAVE2. The reasons for this have been broached above. Not only does SAVE1 include expenditures on all durable goods, but this saving variable is measured as

the residual between observed income and observed expenditures, each of which is measured with error. These measurement errors have the effect of biasing all of the MPSs in the SAVE1 model towards 1.

It should also be noted that the results here do not support the hypothesis that the MPS for total income is a weighted average of the MPSs from the separate sources of income.[6] Based on the average weights of the different sources of income reported in Table 1, the weighted MPS for total income in the SAVE1 model is 0.817, while that for total income in the SAVE2 model is 0.179. Both of these estimated MPS for total income are statistically different from the MPSs for total income reported in Tables 4 and 5 for SAVE1 (0.851) and SAVE2 (0.243).

Finally, it should be noted that the results of Tables 4 and 5 do not conform to those predicted by the life-cycle models. These models generally predict a hump-shaped pattern of saving, with the young and old dissaving and the adults saving. However, with the exception of the variable for household members over 65 (HAGE65) for the SAVE1 model in Table 4, none of the results conform to this pattern. These results are similar to those of Paxson [1992] and Deaton and Paxson [1992], who suggest that in developing countries old-age support comes more from transfers among generations than from any reduction in the marginal rate of saving.

5. Precautionary Saving and the Uncertainty of Income

Since incomes from separate sources are indeed saved at different marginal rates, the question arises: What are the economic reasons for this?

In the literature it is commonly suggested that the reasons for this phenomenon have to do with income variability and uncertainty: all other things being equal, sources of income which are more variable and less certain will tend to be saved at a higher marginal rate. While this may be true, different models of saving treat the effects of variability and uncertainty differently. In the permanent income hypothesis, put forth by Friedman [1957], the marginal utility of consumption is linear, the expectation of marginal utility is the marginal utility of the expectation, and so increases in future uncertainty do not by themselves affect saving. However, newer models of saving treat uncertainty differently. The precautionary model, for example, assumes that the marginal utility of consumption is convex, so that increases in the uncertainty of income lead to a reduction in current consumption and an increase in saving. In the precautionary model, increases in uncertainty raise the valuation of future consumption, because of the inclusion of more possible states when the valuation of consumption is very high: and this increases the marginal incentive to save in the present. Following Deaton [1992: 64], the precautionary model of saving can be written as:

$$E_t \Delta \ln c_{t+1} = \rho^{-1}\left(E_t r_{t+1} - \delta\right) + \frac{1}{2}\rho\omega_t^2 \qquad (13)$$

where ω_t^2 is the time t variance

$$\omega_t^2 = \mathrm{var}_t\left(\Delta \ln c_{t+1} - \rho^{-1} r_{t+1}\right) \qquad (14)$$

According to equations (13) and (14), the expected utility of a change in consumption (c) in time period t +1 depends on the household's risk aversion (ρ) to expected changes in the real rate of interest (r) and consumption growth, where consumption growth is greater

the larger is risk aversion (ρ) and the larger is uncertainty as measured by ω_t^2. The last term in equation (14) is the contribution of the precautionary model, postponing consumption in the face of (income) uncertainty.

Precautionary saving models, like those in (13) and (14), are difficult to operationalize and solve. However, equation (13) reveals an important insight due to Carroll [1991]. Any variable that helps predict the future variability of consumption, for example, current income, will have a role in predicting the growth rate of consumption (and also saving).

For the purposes of this paper, it is possible to hypothesize that households look to the future when they decide to save, and that they choose to save based on how much they expect their current income to vary. More specifically, it can be hypothesized that households will save more of their income from those sources of income that are variable and uncertain at present. In this case, income uncertainty is somewhat similar to Campbell's "saving for a rainy day" [1987], except that here the focus is on saving based upon uncertainty about the level of a specific source of income.

To measure income variability or uncertainty at the household level, two measures have been posed in the literature [Carrroll and Samwick, 1998]. The first measure is the variance of income. As noted above, it has usually been assumed that utility has a constant-absolute-risk-aversion (CARA) form, and that the shock to income is additive and distributed normally with a variance of σ^2. These assumptions have been motivated not so much by plausibility but by the permanent income hypothesis that implies an exact linear relationship between consumption and uncertainty. The second measure of uncertainty used in previous work is the variance of the log of income. While

Carroll and Samwick [1998: 412] note that there is no formal theoretical justification for using this measure, it has the twin advantage of being relatively easy to calculate and of being perhaps the most familiar measure of variability.

Using these two measures of uncertainty, the following method was used to estimate the effect of uncertainty on savings. Using the results from equation (12), marginal propensities to save were estimated for each household i from each of the n separate sources of income. The resulting values were then regressed on either: (a) the variance of the lagged value of each n source of income; or (b) the variance of the log of the lagged value of each n source of income. Dropping the household i subscripts, the basic specification used was:

$$\lambda(\text{MPS})(y_{nt}) = b_o + b_1(\text{VAR})(y_{nt-1}) + \mu \qquad (15)$$

or

$$\lambda(\text{MPS})(y_{nt}) = b_o + b_1(\text{VARLY})(y_{nt-1}) + \mu \qquad (16)$$

where VAR is the variance of n source of income and VARLY is the variance of the log of n source of income in year t.

Equations (15) and (16) were estimated by OLS on the pooled, 5-year data using the two different definitions of savings: SAVE1 and SAVE2. The results are presented in Table 6. In the table, for each definition of savings, the seven sources of income are listed from high to low on the basis of their overall marginal propensities to save (as reported in Tables 4 and 5).

For the SAVE1 model in Table 6, greater variability or uncertainty in lagged income does not explain differences in the propensity to save from income because there is no positive relationship between the two variables. The reason for this may be

measurement error. Since SAVE1 is measured as the residual between two observed variables (income and expenditures), each of which is measured with error, all of the MPSs in the SAVE1 model are biased. It is likely that such biases conceal the effects of income uncertainty on savings rates from the different sources of income.

However, for the SAVE2 model in Table 6 the findings are quite different. Here variability or uncertainty in lagged income does seem to explain the differences in marginal savings rates between separate sources of income. In the SAVE2 model those sources of income which are most variable are also those with the highest marginal propensity to save, and as the value of income uncertainty falls so does the marginal propensity to save. This is exactly what the precautionary model of saving predicts, and unless some alternative explanation can be found, suggests that households in rural Pakistan do indeed save more at the margin from those sources of income which are more variable and uncertain.

6. Conclusion

Three key findings emerge from this study which has used five-year panel data to examine how rural households in a developing country save from each of the full complement of income sources at their disposal.

First, contrary to much work which assumes that the marginal propensity to save (MPS) is the same for all sources of income, this paper shows that separate sources of income are saved at significantly different marginal rates. For example, the MPS out of other income (1.025) is twelve times higher than the MPS for rental income (0.085). Moreover, this finding is robust over different definitions of savings. No matter how

saving is defined, there are large and statistically significant differences in the marginal rates at which income is saved from separate sources of income.

Second, in investigating the economic reasons for this phenomenon, this paper points to the importance of income variability and uncertainty. Just as predicted by the precautionary model of savings, those sources of income which are more variable and less certain will be saved at a higher marginal rate, all other things being equal. Confronted with incomplete capital and credit markets, residents of rural Pakistan seem to save "for a rainy day" by putting away at the margin more of those sources of income which vary more now (and presumably also in the future).

Third, this paper shows the importance of having observed estimates of saving in order to overcome measurement problems in estimating saving. For example, there is no particular relationship between income variability and marginal saving rates when saving is estimated as the residual between two variables (income and expenditures), each of which is measured with error, and together which may be correlated with saving. However, when saving is measured more accurately and without bias — using observed values -- sources of income which are more variable are saved at a higher marginal rate. From a methodological standpoint, in order to accurately estimate marginal propensities to save using regression analysis, it is important to remove the bias caused by the correlation of errors between the dependent and independent variables.

Notes

1. While none of these studies analyze how households save from each of the full complement of income sources at their disposal, two studies examine how households save from several different income sources. Bhalla [1978] uses three-year panel data from rural India to analyze the MPS for two sources of income: agricultural and non-agricultural. Using a shorter, three-year version of the panel data set from rural Pakistan used in this paper, Alderman [1996] examines marginal rates of saving for three income sources: domestic remittances, international remittances and pensions.

2. These data were collected by the International Food Policy Research Institute (IFPRI) working in collaboration with Pakistani research institutes: Applied Economic Research Centre (University of Karachi), Punjab Economic Research Institute (Lahore), the University of Baluchistan (Quetta), and the Center for Applied Economic Studies (University of Peshawar). For more details, see Adams and He [1995].

3. The 469 households were distributed as follows: 84 from Attock District (Punjab province), 166 from Badin District (Sind province), 127 from Dir District (Northwest Frontier Province), and 92 from Faisalabad District (Punjab province).

4. In her study using household data from rural Thailand, Paxson [1992] shows the importance of adjusting income and savings data for inflation.

5. The level of female education in rural Pakistan is very low. See, for example, Adams [1998].

6. For example, in their analysis of the marginal propensity to consume (MPC) separate types of income, Holbrook and Stafford [1971: 19] suggest that the MPC for total income is "merely a weighted average of common propensities to consume different types of income, with the weights being the fraction of the total income represented by each type of income."

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Table 1—Summary of mean annual per capita household income and consumption expenditure data from rural Pakistan, 1986-87 to 1990-91

Year	Consumption	Income						
	expenditure[a/]	Non-farm	Agricultural	Livestock	Rental	External Remittances	Internal Remittances	Other[b/]
1986-87	2,170.09	937.64	661.26	465.73	465.01	247.22	276.89	-15.44
	(1,280.76)	(1,090.32)	(1,559.87)	(578.69)	(1,829.74)	(951.95)	(551.53)	(256.58)
1987-88	2,154.50	1,117.16	807.46	416.98	299.26	269.74	139.23	99.22
	(1,236.33)	(1,257.51)	(2,072.42)	(688.41)	(2,229.84)	(1,262.82)	(380.17)	(507.32)
1988-89	1,907.15	906.26	699.00	417.53	315.75	127.53	59.39	106.72
	(1,194.00)	(1,043.21)	(1,611.23)	(533.98)	(1,903.84)	(674.55)	(189.88)	(365.78)
1989-90	1,901.53	955.79	436.25	330.93	176.65	178.89	54.13	23.70
	(1,648.86)	(1,053.29)	(738.12)	(409.73)	(654.41)	(772.28)	(223.18)	(101.14)
1990-91	2,358.16	922.26	597.62	256.25	282.42	293.74	129.01	28.76
	(1,951.35)	(1,026.50)	(1,221.20)	(482.75)	(1,042.25)	(1,576.49)	(450.45)	(125.93)
Average	2,098.28	967.82	640.32	377.48	307.82	223.42	131.73	48.59
	(1,500.21)	(1,009.14)	(1,511.04)	(551.39)	(1,641.89)	(1,099.66)	(392.08)	(314.11)

Notes: N = 469 households. Standard deviations are given in parenthesis. All data in constant 1986 rupees; in 1986, 1 Pakistan rupee = US $0.062

a/ Consumption expenditure includes expenditures on food and drink, clothing, ceremonies, cinema and medical.

b/ Other income includes government pensions, cash and zakat (payments to the poor).

Table 2—Savings and income by quintile group in rural Pakistan, 1986–87 to 1990–91

Percent of 469 households ranked by 5-year average total per capita income	5-year average per capita household income	5-year average per capita household savings (SAVE1)[a]	5-year average per capita household savings (SAVE2)[b]
Lowest 20%	1,185.27	-433.77	95.90
	(214.56)	(569.64)	(457.92)
Second 20%	1,746.09	-40.46	141.34
	(137.65)	(538.00)	(940.57)
Third 20%	2,239.03	263.44	137.44
	(161.16)	(568.99)	(612.90)
Fourth 20%	2,939.28	682.86	512.60
	(259.02)	(781.70)	(1,092.30)
Top 20%	5,360.21	2,521.37	1,146.66
	(2,776.45)	(2,601.66)	(2,958.75)
Average	2,697.19	589.91	407.45
	(1,917.66)	(1,648.22)	(1,558.37)

Note: N = 469 households. Standard deviations are given in parentheses. All data in constant 1986 rupees; in 1986, 1 Pakistan rupee = US$0.062.

[a/] SAVE1 = Income - consumption expenditure
[b/] SAVE2 = Net real and financial savings

Table 3—Variable definitions

Variable	Definition
SAVE1	Income minus consumption expenditure
SAVE2	Net real and financial savings
Y_{TOT}	Total per capita household income
Y_{NF}	Per capita household non-farm income
Y_{AG}	Per capita household agricultural income
Y_{LV}	Per capita household livestock income
Y_{RN}	Per capita household rental income
Y_{EXT}	Per capita household income from external remittances
Y_{INT}	Per capita household income from internal remittances
Y_{OTH}	Per capita household income from other income
$HAGE1_{0-5}$	Number of people in household aged 0-5 years
$HAGE2_{6-11}$	Number of people in household aged 6-11 years
$HAGE3_{12-17}$	Number of people in household aged 12-17 years
$HAGE4_{18-64}$	Number of people in household aged 18-64 years
$HAGE5_{65-}$	Number of people in household aged 65 or older
MEDUC1	Number of males in household with primary or less education
MEDUC2	Number of males in household with middle school education
MEDUC3	Number of males in household with high school education

Note: All monetary variables are measured in constant 1986 rupees; in 1986, 1 Pakistan rupee = US $0.062

Table 4— Savings function for SAVE1 (Income - consumption expenditure) using OLS

Variable	Combined income	7 income components
Y_{TOT}	0.851	--
	(68.387)**	
Y_{NF}		0.829
		(30.264)**
Y_{AG}		0.859
		(42.120)**
Y_{LV}		0.710
		(13.255)**
Y_{RN}		0.852
		(45.605)**
Y_{EXT}		0.907
		(33.708)**
Y_{INT}		0.589
		(7.665)**
Y_{OTH}		0.799
		(8.472)**
$HAGE1_{0-5}$	125.832	116.155
	(6.836)**	(6.275)**
$HAGE2_{6-11}$	81.219	67.788
	(3.859)**	(3.195)**
$HAGE3_{12-17}$	84.891	81.302
	(3.071)**	(2.925)**
$HAGE4_{18-64}$	-2.636	0.289
	(-0.192)	(0.021)
$HAGE5_{65-}$	-96.346	-100.499
	(-2.019)*	(-2.105)*
MEDUC1	-78.244	-78.737
	(-2.560)*	(-2.549)*
MEDUC2	-90.504	-90.459
	(-1.933)	(-1.938)
MEDUC3	-4.041	18.401
	(-0.052)	(0.235)
Constant	-2,087.047	-1,995.523
	(-26.031)**	(-22.121)**
Adj. R^2	0.671	0.673
F-Stat[a]	531.621	323.014

Notes: Data are pooled over 5 years.
N =469 households/2,345 observations. Numbers in parentheses are t-statistics (two-tailed).

[a/] The reported F-statistic is a joint test of the null hypothesis that the coefficients on the separate income source variables are equal to one another. The null hypothesis of equal coefficients is rejected.

* Significant at the 0.05 level.

Table 4 - Savings function for SAVE1 (contd)

** Significant at the 0.01 level.

Table 5—Savings function for SAVE2 (Net real and financial savings) using OLS

Variable	Combined income	7 income components
Y_{TOT}	0.243	--
	(9.756)**	
Y_{NF}		0.210
		(3.913)**
Y_{AG}		0.116
		(2.904)**
Y_{LV}		-0.175
		(-1.675)
Y_{RN}		0.085
		(2.322)*
Y_{EXT}		0.711
		(13.509)**
Y_{INT}		0.291
		(1.941)
Y_{OTH}		1.025
		(5.559)**
$HAGE1_{0-5}$	30.206	35.745
	(0.818)	(0.988)
$HAGE2_{6-11}$	-54.556	-71.970
	(-1.291)	(-1.736)
$HAGE3_{12-17}$	7.458	26.323
	(0.134)	(0.485)
$HAGE4_{18-64}$	23.634	15.842
	(0.856)	(0.584)
$HAGE5_{65-}$	38.641	79.230
	(0.403)	(0.849)
MEDUC1	75.637	2.036
	(1.233)	(0.034)
MEDUC2	173.952	158.422
	(1.851)	(1.737)
MEDUC3	174.851	235.659
	(1.113)	(1.539)
Constant	-533.657	-251.167
	(-3.316)**	(-1.454)
Adj. R^2	0.055	0.110
F-Stat[a]	16.104	20.411

Notes: Data are pooled over 5 years.
N =469 households/2,345 observations. Numbers in parentheses are t-statistics (two-tailed).

[a/] The reported F-statistic is a joint test of the null hypothesis that the coefficients on the separate income source variables are equal to one another. The null hypothesis of equal coefficients is rejected.

* Significant at the 0.05 level.

Table 5—Savings function for SAVE2 (contd)

** Significant at the 0.01 level.

Table 6. Regressions of marginal propensity to save on uncertainty measures

(a) SAVE1 (Income minus consumption expenditure)

Source of income	MPS[1]	Variance of income (Y_{t-1})	Variance of log of income (Y_{t-1})	Constant	Adj R^2
External remittance:	0.907	1.212	1.702	312.2	0.301
		(2.812)**	(2.53)**		
Agricultural income	0.859	0.713	0.812	278.3	0.336
		(2.164)**	(3.01)**		
Rental income	0.852	0.605	0.791	164.1	0.402
		(3.104)**	(1.97)*		
Non-farm income	0.829	0.971	0.952	343.2	0.41
		(2.987)**	(2.07)*		
Other income[2]	0.799	1.103	0.962	237.1	0.401
		(2.92)*	(3.07)*		
Livestock income	0.71	0.452	0.501	142.2	0.254
		(1.96)*	(2.01)*		
Internal remittances	0.589	0.607	0.619	115.1	0.381
		(1.98)*	(2.11)*		

(b) SAVE2 (Net real and financial savings)

Source of income	MPS[1]	Variance of income (Y_{t-1})	Variance of log of income (Y_{t-1})	Constant	Adj R^2
Other income[2]	1.025	1.402	1.315	328.3	0.451
		(3.020)**	(3.171)**		
External remittance:	0.711	1.017	0.945	261.2	0.501
		(3.780)**	(4.012)**		
Internal remittance	0.291	0.962	0.874	478.2	0.418
		(3.811)**	(4.50)**		
Non-farm income	0.21	0.621	0.599	189.6	0.58
		(3.010)**	(2.187)**		
Agricultural income	0.116	0.581	0.572	310.5	0.455
		(5.101)**	(5.02)**		
Rental income	0.085	0.472	0.512	210.6	0.414
		(2.151)*	(1.971)*		
Livestock income	-0.175	-0.217	-0.243	497.1	0.406
		(-1.10)	(-0.981)		

Notes: Data are pooled over 5 years. N=469 households/2,345 observations. Numbers in parentheses are t-statistics (two-tailed).

[1/]Marginal propensity to save (MPS) calculated from equation (12) and listed in Tables 4 and 5.

[2/]Other income includes government pensions, cash and zakat (payments to the poor).

*Significant at the 0.05 level.
**Significant at the 0.01 level.

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